International Journal of Agricultural
Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 6, Issue 1, Feb 2016, 31-36

TRANS STELLAR
•Journal Publications •Research Consultancy

EVALUATION OF DIFFERENT COCOA CLONES UNDER DIFFERENT ECOLOGICAL CONDITION OF TAMIL NADU FOR BEAN CHARACTERS

K. MURALI[1] & J. SURESH[2]

[1]*Research Scholar, Department of Spices and Plantation Crops, HC & RI, TNAU, Coimbatore, Tamil Nadu, India*

[2]*Professor and Head, Department of Spices and Plantation Crops, HC & RI, TNAU, Coimbatore, Tamil Nadu, India*

ABSTRACT

Seven improved clones of cocoa (CCRP 1, CCRP 2, CCRP 3, CCRP 4, CCRP 5, CCRP 6, CCRP 7) were planted at different ecological condition of Tamil Nadu and their performance were evaluated for two seasons for bean characters during 2014-2015. The results indicated that there were difference among the clones under different locations with respect to bean characters. The results revealed that CCRP 3 recorded the highest number of beans both at Aliyar Nagar (43.2 & 41.2) and Coimbatore (44.5 & 42.4) conditions. CCRP 5 registered the highest single dry bean weight at Aliyar Nagar (1.49 g & 1.30 g), at Coimbatore (1.31 g & 1.23 g) condition where as CCRP 4 recorded the highest pod weight (318.4 g & 315.3 g), number of beans (41.3, 43.0) and single dry bean weight (1.41 g & 1.30 g) at Thadiyankudisai condition during first and second seasons respectively.

KEYWORDS: Cocoa, Locations, Number of Beans, Fresh Bean Weight and Dry Bean Weight

Received: Dec 07, 2015; **Accepted:** Dec 14, 2015; **Published:** Dec 26, 2015; **Paper Id.:** IJASRFEB20165

Original Article

INTRODUCTION

Cocoa (*Theobroma cacao* L.) is a preferentially allogamous, Neotropica tree species of the family Malvaceae (Alverson *et al*., 1999). *Theobroma* orginated in several native areas of the tropical rainforest of equatorial America, the most important of these being at the foot of the Andes on the upper reaches of the Amazon river (Mossu, 1992). *Theobroma cacao*, is a tropical understorey tree that is a major economic resource to several tropical countries (Lanaud *et al*., 2009). Cocoa bean, the product of commerce is used for the extraction of cocoa butter which forms the principle ingredient in manufacturing of chocolate. Climatic factor *viz*. temperature, humidity, rainfall, wind and sunshine affects the flowering, fruiting and quality of fruits (Rajesh *et al*., 2014). Studies on the effects of temperature on cocoa fruits have been limited to few genotypes and yet cocoa is known to show considerable genetic variation in fruit size, shape and bean size (Bekele *et al*., 2006). The bean size is affected by temperature differences and there exists a relatively weak negative effect of temperature on bean size for the Amelonado variety (Daymond and Hardly, 2008).

Breeding work initiated at the Kerala Agricultural University since 1979 has resulted in the release of seven improved clones of Forastero type, *viz.*, CCRP 1, CCRP 2, CCRP 3, CCRP 4, CCRP 5, CCRP 6 and CCRP 7. These improved clones were selected based on their performance at hot humid tropical zones of Kerala. However, their performance under hot tropical conditions in Tamil Nadu, particularly under Coconut plantations as an understoreyed crop is not known.

This has prompted us to identity / breed varieties specific to those hot tropical conditions of Tamil Nadu. As development of new varieties is a long term process, the immediate step is the evaluation of already released clones / hybrids to assess their suitability to Tamil Nadu conditions also. With this background, performance of polyclones in different locations of Tamil Nadu for bean characters were studied.

MATERIALS AND METHODS

Polyclonal gardens were established in three different locations of Tamil Nadu, *viz.,* Coconut Research Station, Aliyar Nagar, Horticulture Research Station, Thadiyankudisai and Coconut Nursery, Horticultural College and Research Institute, Coimbatore. The released varieties from Kerala Agricultural University *viz.,* CCRP 1, CCRP 2, CCRP 3, CCRP 4, CCRP 5, CCRP 6 and CCRP 7 were taken for this experiment. Grafted plants of these varieties has been planted at spacing of 3 m between 2 rows of coconut at Horticultural College and Research Institute, Coimbatore (warm tropical and less humid tract and non-traditional) and Coconut Research Station, Aliyar Nagar (the traditional cocoa growing area in Tamil Nadu). In Horticulture Research Station, Thadiyankudisai (mid elevation of enjoying a humid tropical climate) the clones were planted as mono crop at a spacing of 3m x 3m. The age of the crops is 4 years old at Coconut nursery, Coimbatore and 5 years old at CRS, Aliyar Nagar and HRS, Thadiyankudisai.

RESULTS AND DISCUSSIONS

The data related to geographical locations of the different experimental sites were furnished in the following Table.1.

Table 1: Geographical Locations of the Three Different Experimental Sites

S. No.	Particulars	Aliyar Nagar	Thadiyankudisai	Coimbatore
1.	Longitude	76º 58º 48 º E	77° E	77^{o} E
2.	Latitude	10º 29º 30 º N	10° N	11^{o} N
3.	Altitude	288 m above MSL	1098 m above MSL	412 m above MSL

Bean Characters

Dried beans are the prime economic produce of cocoa. The number of beans decides the total weight of beans per pod. It is essential to select cocoa genotypes with more number of beans per pod so as to involve either in crop improvement or to utilize in commercial plantations. Among the different clones used (Table 2), CCRP 3 registered highest number of beans per pod at Aliyar Nagar (43.2 and 41.2), Coimbatore (44.5 and 42.4) and CCRP 4 at Thadiyankudisai (41.3 and 43.0) during first and second season respectively. The pooled data revealed that CCRP 3 registered the highest number of beans per pod at Aliyar Nagar (42.2), Coimbatore (43.5) whereas, CCRP 4 at Thadiyankudisai (42.2). In Tamil Nadu, after the dry season of summer (March-May) and two prunings, *viz.,* February-March and June July, the cocoa crop makes good vegetative growth and also better partitioning of synthesized food material for pod and bean production during July to December season which is considered as the best season to get more yield than January to June season.

Similar variation in bean number per pod by entries in hybrid and clonal evaluation trials as well as on farm and germplasm evaluation has been reported earlier by Lamin *et al.* (2011).

Bean, being the economic part of cocoa, focus on genotypes with higher bean weight will enhance production of cocoa (Oyedokun *et al*., 2011). Significant difference were noticed among the clones at different locations of Tamil Nadu for single fresh bean weight (Table 3). CCRP 5 recorded the highest single fresh bean weight at Aliyar Nagar (3.89g and

3.11g), at Coimbatore (3.00g and 2.86g) and CCRP 4 at Thadiyankudisai (2.90g and 2.78g) during first and second season respectively. The pooled data revealed that CCRP 5 registered the highest single fresh bean weight at Aliyar Nagar (3.50g), Coimbatore (2.92g) whereas, CCRP 4 at Thadiyankudisai (2.84g). Adewale *et al*. (2013) reported a positive relationship of pod weight with bean weight, thus a genotype with heavier pods equally means genotypes with higher bean weight. It was observed that the weight of the single fresh bean was higher during July to December season than January to June season. High temperature coupled with dry climate prevailed during flowering and pod development stages of January to June season. Since, a weak and negative relationship exists between temperature and bean size (End *et al*., 1988), the performance of cocoa clones for fresh bean weight was observed to be poor during the season.

Single dry bean weight showed significant difference among the clones at all the three locations (Table 4). CCRP 5 recorded the highest single dry bean weight at Aliyar Nagar (1.49 g and 1.30 g) and Coimbatore (1.31 g and 1.23 g) whereas, CCRP 4 recorded the highest value at Thadiyankudisai (1.41 g and 1.30 g) during first and second seasons respectively. Pooled mean values revealed that CCRP 5 registered the highest single dry bean weight at Aliyar Nagar (1.41 g), Coimbatore (1.31 g) and CCRP 4 recorded (1.33 g) at Thadiyankudisai. Enriquez and Soria (1968) classified the beans as small (< 0.99 g), medium (1-1.5 g) and large (>1.6 g) on dry weight basis. In the current study, it was observed that the dry bean weight ranged from 1.01 to 1.49 g describing the bean size of the cocoa clones ranged from small to medium beans. These variations in bean characters are mainly due to genetic factors and environmental factors as reported by Thondaiman *et al*. (2013). Similar variability was also reported by Elain Aphsara *et al*. (2008) for quantitative traits of cocoa beans.

CONCLUSIONS

It could be concluded that CCRP 3 recorded the highest number of beans and CCRP 5 registered the highest single dry bean weight at Aliyar Nagar and Coimbatore condition where as CCRP 4 recorded the highest number of beans and single dry bean weight at Thadiyankudisai condition during first and second seasons respectively.

ACKNOWLEDGEMENTS

The authors are thankful to the financial support rendered by Mondelez International limited.

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APPENDICES

Table 2: Number of Beans per Pod of Cocoa Clones Grown Under Different Locations of Tamil Nadu

Varieties	Number of Beans per pod								
	Aliyar Nagar			Coimbatore			Thadiankudisai		
	Season I	Season II	Mean	Season I	Season II	Mean	Season I	Season II	Mean
CCRP 1	39.8	36.8	38.3	39.9	36.8	38.5	36.0	35.5	35.8
CCRP 2	41.2	39.3	40.3	39.3	36.7	37.9	35.2	35.0	35.1
CCRP 3	43.2	41.2	42.2	44.5	42.4	43.5	38.1	39.1	38.6
CCRP 4	36.7	35.1	35.9	37.6	35.5	36.5	41.3	43.0	42.2
CCRP 5	40.5	38.6	39.5	41.0	39.4	40.2	38.0	40.0	39.0
CCRP 6	37.0	35.5	36.2	37.9	36.5	37.3	37.0	38.0	37.5
CCRP 7	32.3	33.4	32.8	-	-	-	36.0	35.0	35.5
Mean	38.7	37.1	37.9	40.0	37.9	38.9	37.4	37.9	37.7
SEd	0.69	0.66	0.67	0.96	0.52	0.82	0.55	0.52	0.52
CD (0.05)	1.51	1.44	1.42	2.14	1.11	1.60	1.21	1.11	1.12
Season I : July to December				**Season II: January to June**					

Table 3: Single Fresh Bean Weight of Cocoa Clones Grown Under Different Locations of Tamil Nadu

Varieties	Single Fresh Bean Weight (g)								
	Aliyar Nagar			Coimbatore			Thadiankudisai		
	Season I	Season II	Mean	Season I	Season II	Mean	Season I	Season II	Mean
CCRP 1	3.42	3.01	3.22	2.50	2.42	2.46	2.73	2.70	2.72
CCRP 2	3.34	2.84	3.10	2.80	2.68	2.74	2.60	2.60	2.60
CCRP 3	3.76	2.99	3.38	2.85	2.73	2.79	2.70	2.63	2.67
CCRP 4	3.09	2.79	2.93	2.30	2.32	2.31	2.90	2.78	2.84
CCRP 5	3.89	3.11	3.50	3.00	2.86	2.92	2.80	2.77	2.79
CCRP 6	3.00	2.72	2.91	2.50	2.38	2.44	2.40	2.30	2.35
CCRP 7	3.13	2.81	2.97	-	-	-	2.40	2.32	2.36
Mean	3.38	2.90	3.14	2.66	2.61	2.61	2.65	2.59	2.62
SEd	0.07	0.06	0.07	0.04	0.05	0.04	0.10	0.10	0.10
Table 3: Contd.,									
CD (0.05)	0.16	0.13	0.14	0.10	0.11	0.10	0.14	0.11	0.12
Season I : July to December				**Season II: January to June**					

Table 4: Single Dry Bean Weight of Cocoa Clones Grown Under Different Locations of Tamil Nadu

Varieties	Single Dry Bean Weight (g)								
	Aliyar Nagar			Coimbatore			Thadiankudisai		
	Season I	Season II	Mean	Season I	Season II	Mean	Season I	Season II	Mean
CCRP 1	1.33	1.14	1.23	1.18	1.01	1.10	1.13	1.10	1.12
CCRP 2	1.21	1.02	1.11	1.24	1.12	1.21	1.10	1.10	1.10
CCRP 3	1.35	1.24	1.31	1.26	1.21	1.23	1.30	1.20	1.31
CCRP 4	1.31	1.18	1.24	1.10	1.10	1.10	1.41	1.30	1.33
CCRP 5	1.49	1.30	1.41	1.31	1.23	1.31	1.30	1.27	1.31
CCRP 6	1.12	1.12	1.12	1.11	1.01	1.11	1.03	1.00	1.01
CCRP 7	1.07	1.10	1.09	-	-	-	1.00	1.00	1.00
Mean	1.31	1.15	1.21	1.21	1.11	1.15	1.22	1.14	1.20
SEd	0.02	0.01	0.02	0.02	0.03	0.02	0.05	0.02	0.04
CD (0.05)	0.07	0.03	0.05	0.05	0.07	0.06	0.10	0.04	0.11
Season I : July to December				**Season II: January to June**					